

CHAPTER 5: DATA RECOVERY EXCAVATIONS

As described in the Methods section of this report, data recovery operations were conducted as a scheduled task of within the overall bridge removal process. A cofferdam was constructed around the site, and the flow of Gravelly Run was diverted into a 48-inch-diameter metal culvert (Figure 42). This produced a relatively dry environment within which to remove the fill and structural members associated with the 1936 bridge and to examine the archaeological remains of the milldam and earlier mill-related features.

The cofferdam measured approximately 36 x 70 feet, the long axis extending northeastward from the southern edge of the highway right-of-way. This edge roughly corresponded with the southern face of the milldam that was raised in the 19th century to confine the flow of the Nanticoke River and power the several mills located nearby. The archaeological investigation within the cofferdam encompassed an area that included the milldam and a portion of Gravelly Run upstream from the dam, as well as the ground extending between 15 and 20 feet on either side of the current stream channel as it flows beneath the modern road.

The modern road surface and the underlying fill was removed with a crane-operated clam shell bucket to the level of the bulkhead associated with the 1936 bridge. Additional fill was excavated behind the bulkheads to expose the heavy pinewood sheet pilings that retained the fill. The space between the sheet pilings and the edges of the cofferdam was limited, so that careful excavation with heavy equipment was impractical. Thus the sheets, and the large pine bollards that supported the pilings and cross members, were removed using a vibrating extractor, also crane-operated, that pulled the sheets and piles out individually without disturbing the surrounding ground surface. When completed, the remaining modern fill behind the bulkheads was removed with the clamshell bucket.

Excavation of the underlying fill, that was associated with earlier road berm and dam construction, was undertaken with a backhoe placed at the top of the cofferdam, at the level of the modern road. As the level of fill reached the maximum extent of the backhoe arm, several fragile wooden features became apparent near the cofferdam wall. At this point, mechanical excavation continued through the use of a mini-track hoe, that was lowered into the cofferdam by the crane. The mini-hoe was able to maneuver within the confined areas at the base of the cofferdam, between the diversion culvert and the wooden features lining the cofferdam walls. Using this combination of equipment, it was possible to excavate mechanically to the base of the cultural deposits on either side of the stream and eventually to trench across the stream channel, documenting a series of flood episodes that will be described below.

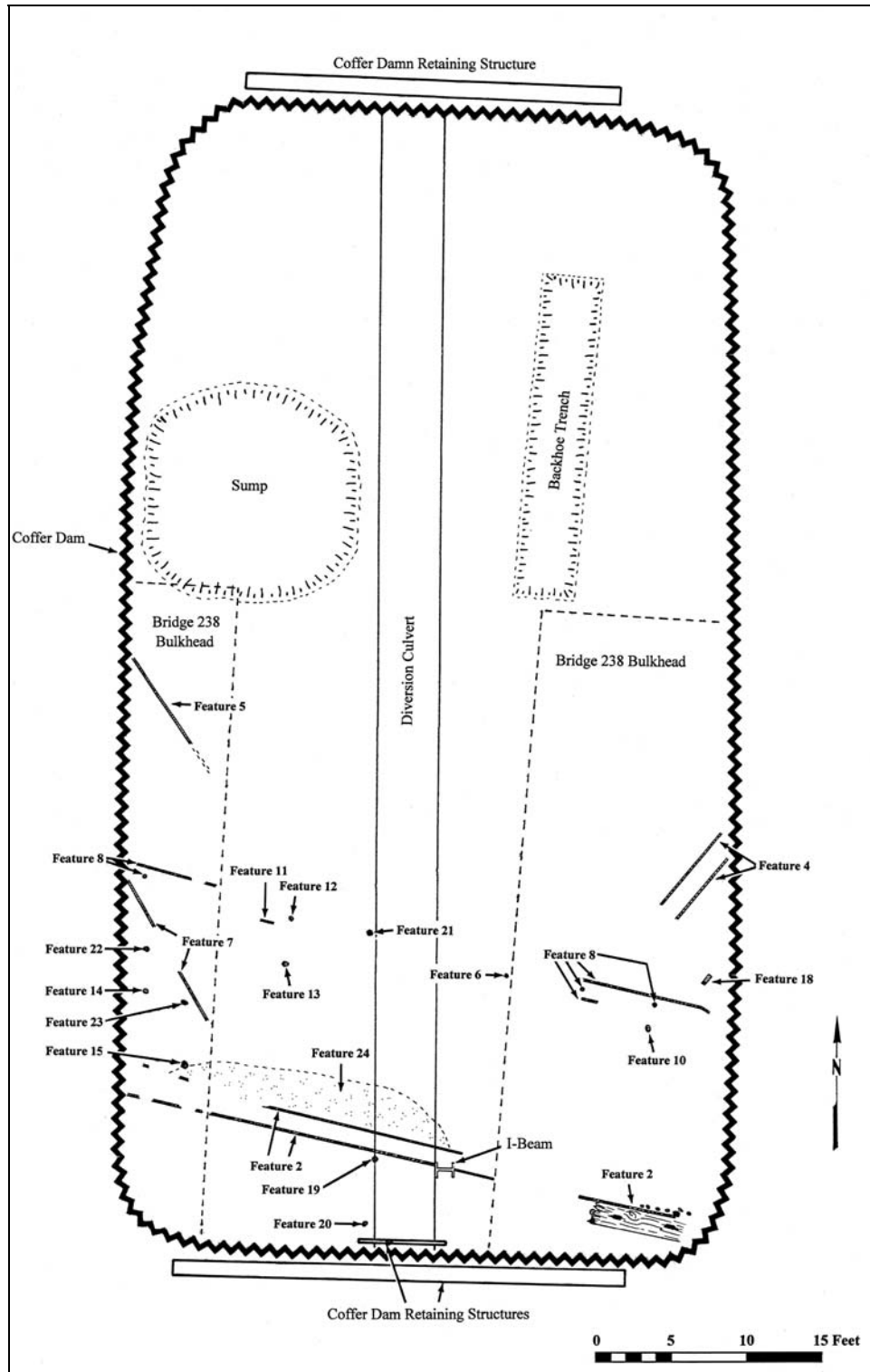


Figure 42: Planview of cofferdam

Figure 43 shows a cross section of the deposits west of the stream, at a point approximately 20 feet north of the southern edge of the cofferdam, near the center of the 1936 bridge bulkhead. The cut clearly shows the effects of historic period construction on the recent evolution of the stream channel. The extensive deposit of comparatively homogeneous, orange sand and clay fill that comprised the mass of the berm associated with the 20th century bridge lay behind the bulkhead. Lying against the cofferdam sheeting, and partially truncated by them, were the remnants of wooden features that it appears were originally associated with water control. They were first observed at depths of 8 to 10 feet below the modern road surface, along with a distinct change in the character of the surrounding fill. The fill became more compact, seen as a mixture of various patches of silty clay, sandy clay, and gravel. At the base of the fill lay a thin deposit of iron-stained and concreted sand, directly over undisturbed subsoil.

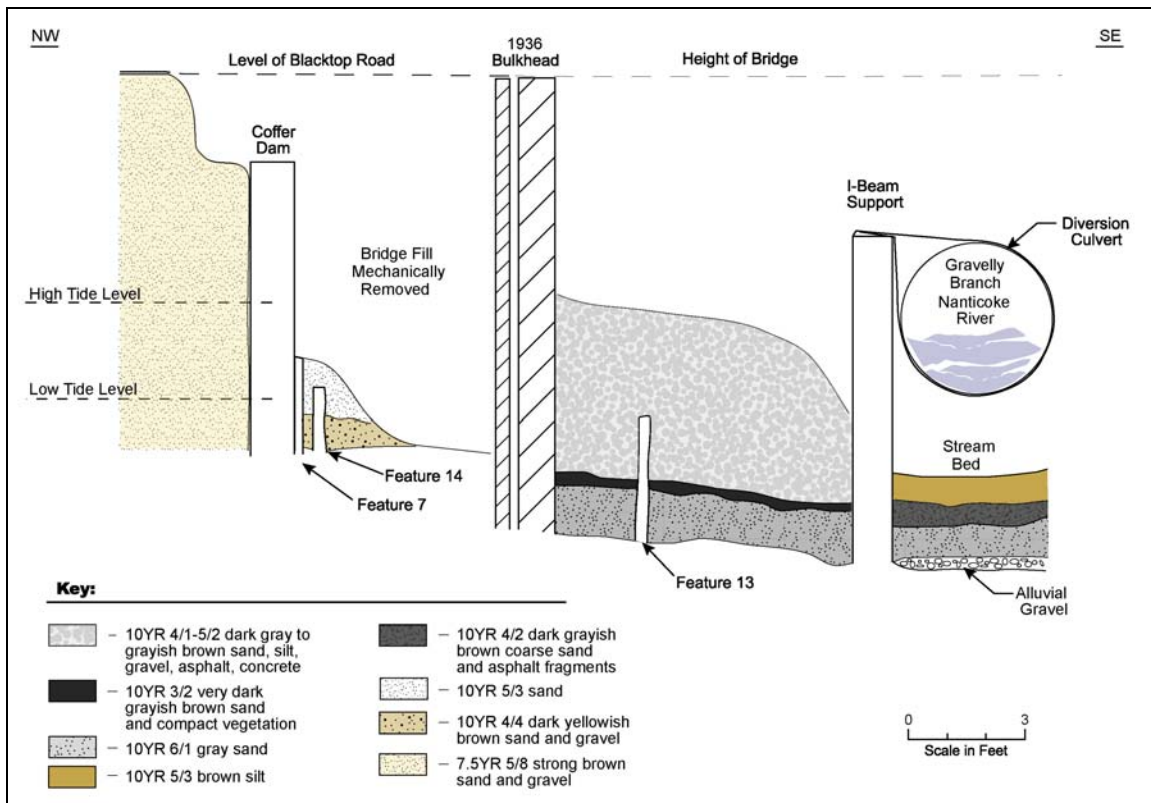


Figure 43: Stratigraphy, Stream cross-section.

To the east, between the bulkhead and the stream channel, lay mixed gray sand and silt, representing the recent floodplain of the stream. The surface of this deposit began as little as 6 feet below the top of the berm, and sloped markedly downward to the east, in the direction of the stream channel. At the base of the silt, 10 to 10.5 feet below modern grade, lay a 3-5 inch thick mat of decomposing vegetation. This material lay at the same level as the base of the stream channel, and thus probably represented tidal flats adjacent to the stream prior to dam construction, before the stream flow was constricted.

Below the vegetation lay clean, undisturbed gray sand, related to the Pleistocene sands that underlie all of the Delaware Coastal Plain.

Beneath the diversion culvert, the bed of Gravelly Branch can be seen. The uppermost layer consisted of the sand and silt that constantly washed in from the surrounding excavations, due to the influx of water from the saturated deposits and from inevitable leaks in the cofferdam. Below this recent deposit, the streambed consisted of distinct layers of gravel, mixed with brick, coal and asphalt debris, interbedded with layers of silt and clean, sorted gravel. These deposits and their implications for the development of the stream channel will be considered in more detail later.

The cross section on the east side of the stream, at a point just over 40 feet north of the cofferdam wall, immediately north of the modern bridge bulkhead was simpler. It consisted of stacked fill deposits overlying natural flats and undisturbed subsoil. The layer of organic debris seen on the west side of the stream did not occur consistently on the east side.

The sediment strata illustrated in the two cross sections typified the deposits across the entire cofferdam excavation. Briefly summarized, within the bulkheads forming the 1936 bridge lay undifferentiated fill used to support the road surface. Between the bulkheads lay silty floodplain material associated with the stream and probably laid down since its confinement by the dam. Tidal wetland deposits underlay the recent silts, cut by the present stream channel. North of the bridge bulkhead, fill deposits were somewhat more varied, suggesting less planning in the deposition, since this portion of the berm was not intended to carry the load of the modern roadway.

The material of greatest archaeological interest lay beneath the bridge fill and recent floodplain deposits, in the form of wooden features that appeared to be connected with pre-20th century water control. The remainder of the archaeological descriptions will detail these features. The features were numbered arbitrarily in the field, in order of discovery. Further analysis has shown that there is a logical order to the features that supercedes the field numbering system, and so the features are grouped for this presentation according to their apparent association. In general, the features appeared to be associated with three parallel bulkheads that extended across the width of the stream channel. A list of the groups and their constituent features follows in Table 6. A plan view of the cofferdam excavation showing the bulkheads is shown in Figure 44.

Table 6: Archaeological Features Grouped by Structural Association

Group	Features	Description
<i>Bulkhead 1</i>		
	Feature 1	sheet piling and supports
<i>Bulkhead 2</i>		

Table 6: Archaeological Features Grouped by Structural Association

Group	Features	Description
	Feature 2	sheet piling and supports
	Feature 7	wing wall sheet piling
	Feature 14	Post
	Feature 15	Post
	Feature 16	bulkhead sheet piling
	Feature 19	Post
	Feature 22	Post
	Feature 23	Post
	Feature 25	Post
	Feature 26	Post
<i>Bulkhead 3</i>		
	Feature 4	wing wall sheet piling and supports
	Feature 5	wing wall sheet piling and supports
	Feature 6	Post
	Feature 8	bulkhead sheet piling and supports
	Feature 9	Post
	Feature 10	Post
	Feature 11	bulkhead sheet piling
	Feature 12	Post
	Feature 17	wing wall sheet piling and supports
	Feature 21	Post
<i>Isolated</i>		
	Feature 3	planks associated with 1936 bulkhead
	Feature 13	Post
	Feature 18	isolated vertical plank
	Feature 20	Post
	Feature 24	cut-and-fill deposit

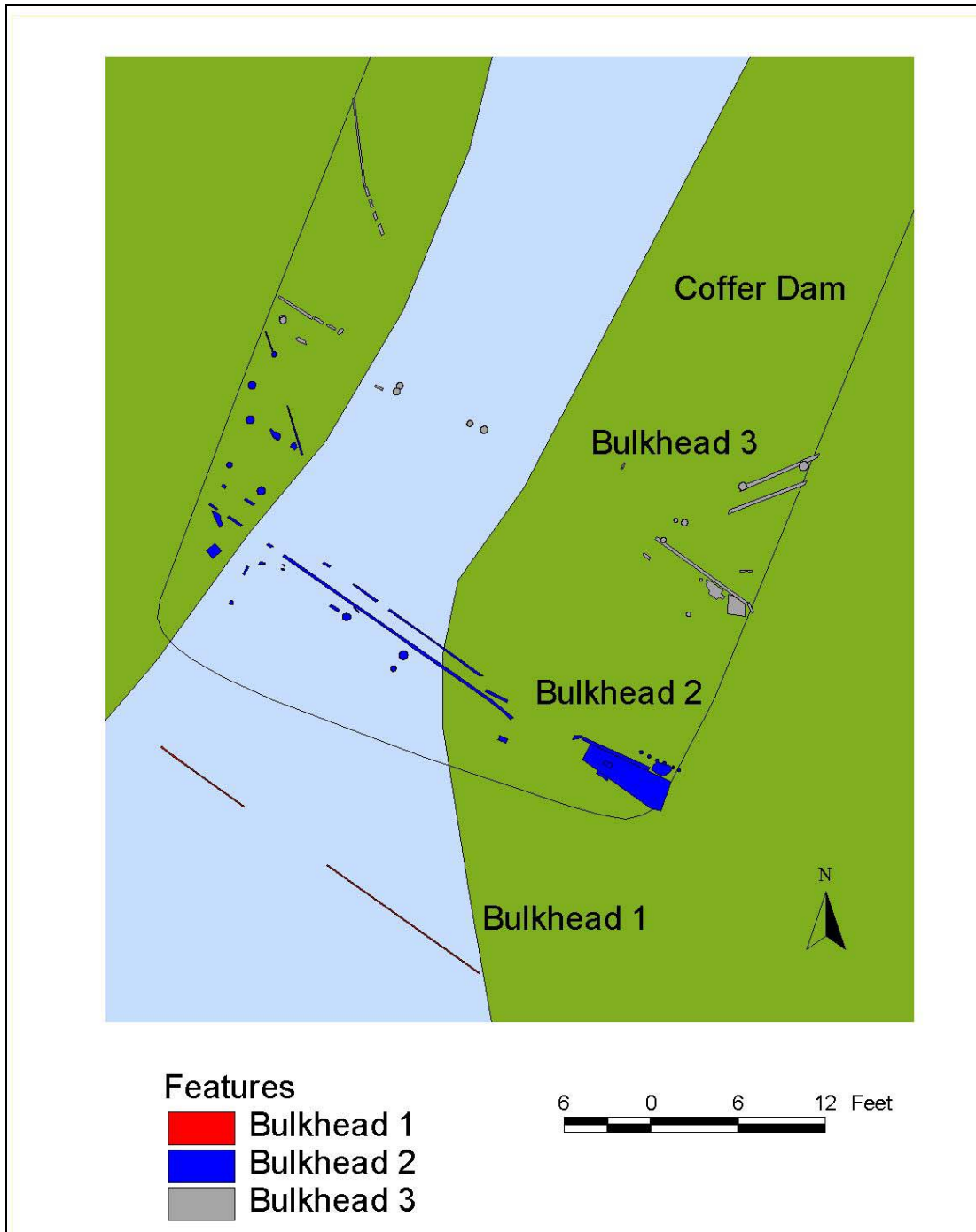


Figure 44: Planview of Bulkheads

BULKHEAD 1

Feature 1

The material comprising Bulkhead 1 lay south of, or downstream from the cofferdam, at the edge of the wide and deep ponded area thought to be a quarry pit. The

bulkhead was investigated as an underwater component of the site during the survey portion of the project. It was documented as a single feature, designated Feature 1. Due to its location outside of the cofferdam, the bulkhead was not investigated further during the data recovery phase of the project. Feature 1 consisted of a single line of 2 x 6-inch planks set vertically in the stream bottom at the edge of the basin of the quarry cut. The line of the planking ran east-west across the stream, and the planks extend from both the east and west banks. There is a gap of approximately 7.25 feet, west of the center of the line and corresponding with the main channel of the stream. At the west end, the planking extended beneath rip-rap at the base of the road berm that consisted of large chunks of macadam. Removal of several of these blocks revealed an anchoring system, comprised of a 10 x 10-inch timber set into the bank and attached to the planking on the south, or downstream side. The connecting planks consisted of several 2-ply planks of varying widths, fastened by large cut nails. The large, anchoring timber appeared to have been recycled, since there is a 5-inch-deep scarf joint cut into the wood, but no evidence, such as fasteners or holes, to indicate that additional timbers had been attached to it: the notch was weathered at the east (stream) end, and there were no other timbers extending into the stream.

There was no indication of a similar anchoring system on the east bank. No additional wood was found beyond the last plank visible at low tide. It may be that the slope of the bank here was not as steep, due to the shape of the quarry cut, and that the planking was sheltered from currents and so did not need extensive anchoring. Alternatively, the anchoring timbers may have been removed for other purposes.

Except for the anchor at the west end, the planks forming Feature 1 were free standing. They were deeply buried in the streambed; no supporting posts were observed. Nor was there evidence of posts or hardware (hinges, pintles, gudgeons, etc.) at the gap ends of the planking, such as would be expected had gates been present. There were several large, cut nails in the planks, driven through the upstream side, but no signs of any attachment.

Two test excavations, Test Units 1 and 3, were placed below the waterline to further investigate Feature 1. Both units measured 1 m², and both were located on the upstream side of the bulkhead, Test Unit 1 near the west end of the feature, and Test Unit 3 at the east end. Each unit contained a surface layer of recent, silty and somewhat mucky or organic alluvium, followed by clean, coarse-grained sand with small gravels extending at least 1 m in depth (the base of this deposit was not reached). Modern glass and metal artifacts, as well as earlier artifacts such as cut or wrought nails, and molded brick, were recovered from both layers in each unit.

BULKHEAD 2

Bulkhead 2 consisted of a run of low sheet piling that stretched across the channel of Gravelly Run. It was reinforced by posts, and, at the east end, by a massive timber.

Most of the feature was poorly preserved. A portion near the east wall of the cofferdam was relatively intact, and measurements there indicated that originally the bulkhead rose approximately to current mean sea level. The remnants of a wing wall were present on the western side of the bulkhead. This feature consisted of similar sheet pilings supported by several posts, intersecting the bulkhead at an oblique angle. There may have been a corresponding wall on the eastern end of the bulkhead, but if so, it lay beyond the area exposed in the cofferdam. The east end, as revealed by excavation within the dam, consisted of a grate formed by a series of small posts placed on the upstream side of a gap in the bulkhead planks. The main segments of the bulkhead, within the streambed and east of the stream, were excavated as Features 2 and 19. Portions of the sheet piling and posts west of the stream were excavated as Features 15 and 16. The wing wall was excavated as Features 7, 14, 22 and 23. The individual features are described in detail below.

Main Bulkhead

Feature 2

Feature 2 consisted of a series of sheet piles, associated posts and reinforcing timbers (Figure 45). Two segments were identified. One, located in the center of the streambed, was originally documented in the survey and testing phase of the project. That investigation took place underwater, before the cofferdam and diversion culvert were proposed, and thus several questions remained about the function and integrity of the planks and posts making up the feature (Figure 46). They were described at the time as two parallel sets of 2 x 6-inch sheet piles, separated by a space of approximately 12 inches. A 6-inch-diameter wooden post was set approximately 6 inches to the south, downstream from the sheets.

The second portion of Feature 2 lay beneath the fill of the 1936 bridge, and was exposed by mechanical and hand excavation, after the heavy posts and pilings of the bridge bulkhead were removed. The sheets consisted of pinewood boards, 2 inches thick, ranging from 8.5 to 10 inches wide, and 6.5 to 7.5 feet in length. They had been driven into the ground, rather than placed in an excavated ditch, as evidenced by both the lack of disturbance in the subsoil typically associated with a trench, and by the ends of the planks. The ends were trimmed to a point (double-bevel) relative to thickness, and finished with a single bevel relative to width (Figure 47). The pointed finish allowed the planks to be driven more easily into the clayey soil, while the single bevel acted to force each plank against the adjacent plank. As the wood became wet and swelled, pressure on the joint would have increased, producing a watertight fit¹. There was no evidence of the type of damage, or mushrooming at the upper ends of the boards that would be expected from driving them deeply into the subsoil, suggesting that the planks had then been driven in and then cut cleanly at a specific level. As noted above, the level at which they had been cut appeared to correspond with current mean sea level.

¹ this same technique was used for the sheet piles comprising the 1936 bridge bulkhead.

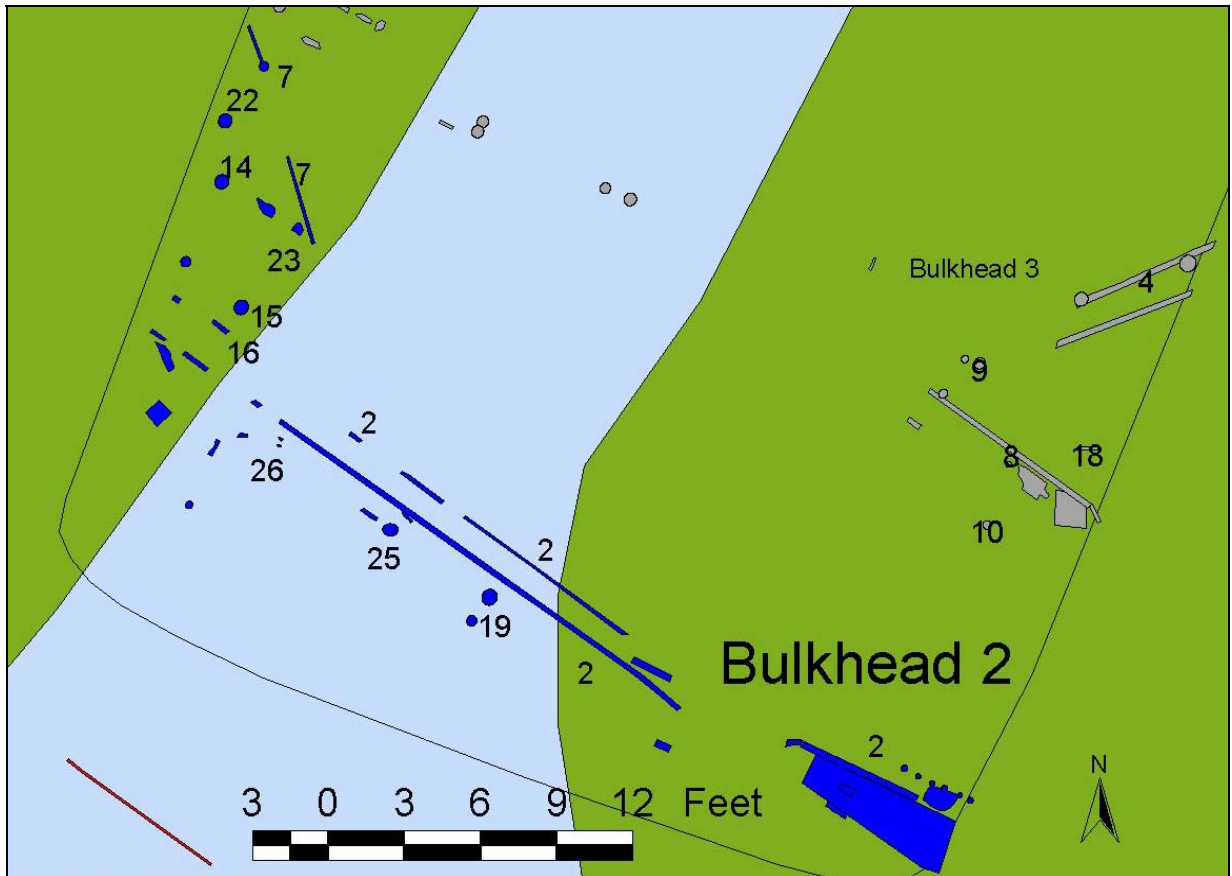


Figure 45: Planview Bulkhead 2.



Figure 46: Central portion of Feature 2, underneath the diversion culvert. Facing Southeast.

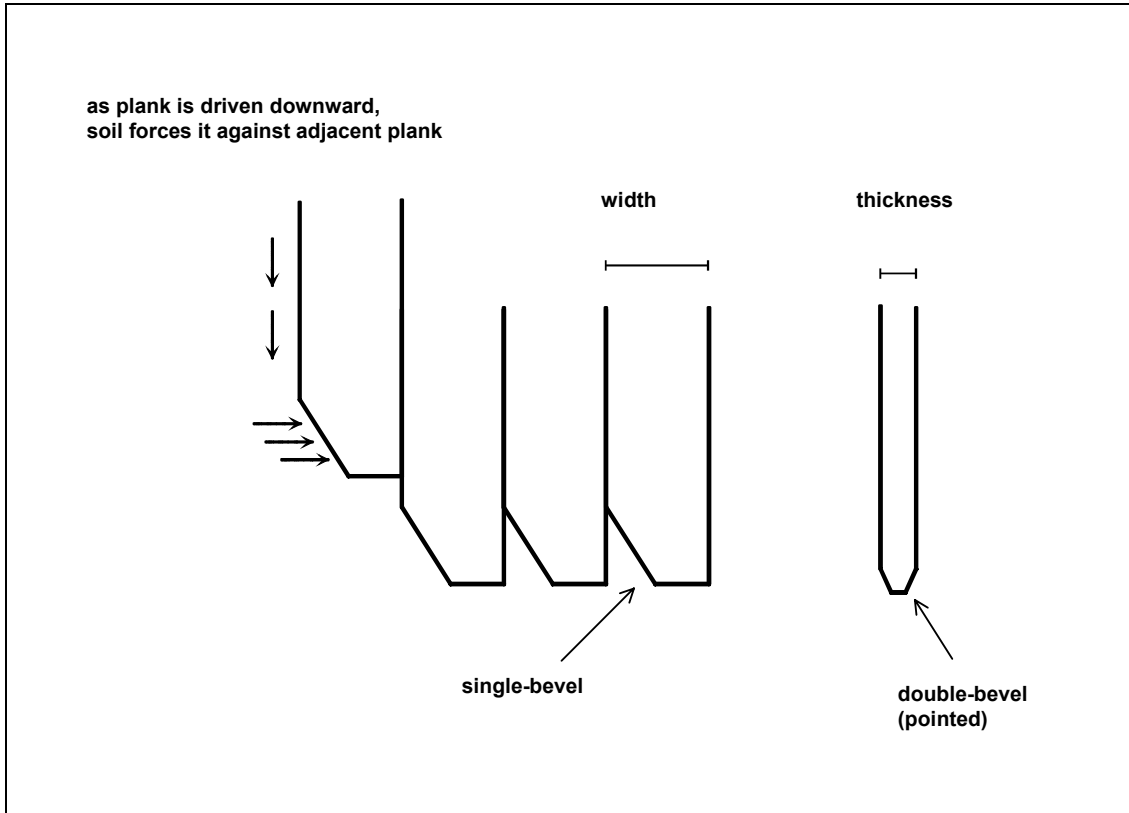


Figure 47. Schematic Diagram of Sheet Piling Installation.



Figure 48: East End, Bulkhead 2, Feature 2, Crash Rack. Facing South

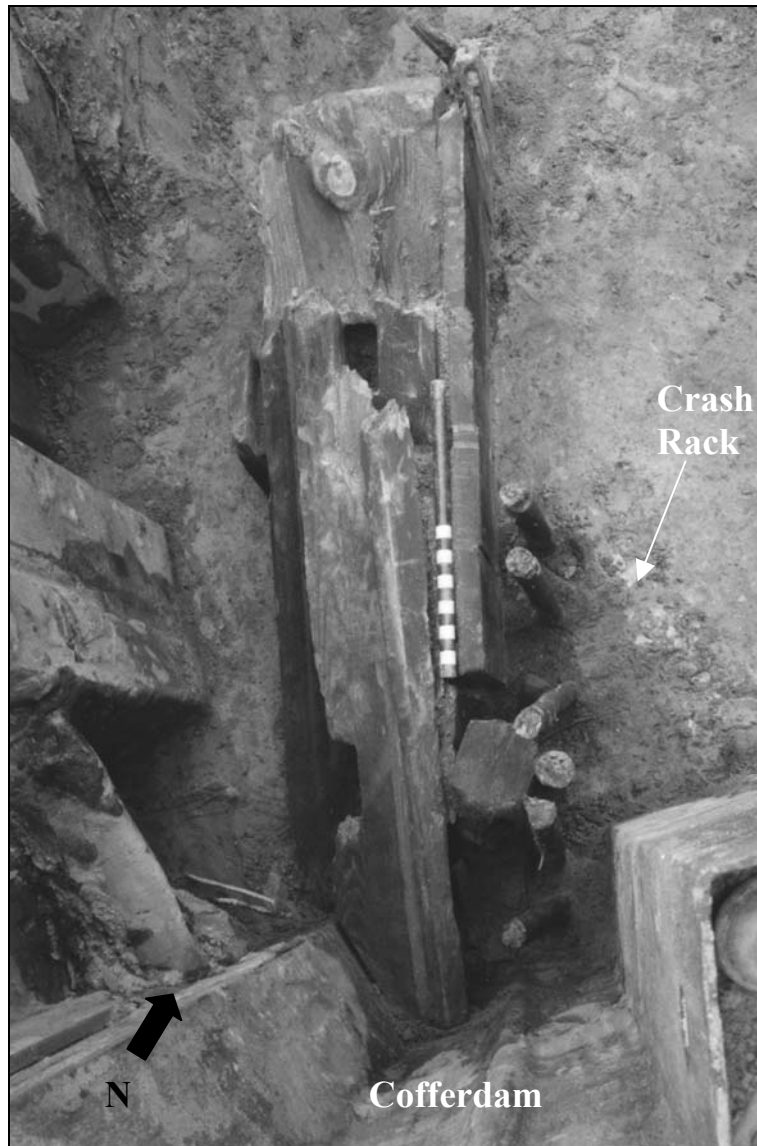


Figure 49: Overhead view of Bulkhead 2, Feature 2 and Crash Rack

At the east end, the bulkhead consisted of a single line of sheet piles, reinforced with posts and a heavy timber. Only one of the posts remained. It consisted of pinewood, measuring 4.5 inches in diameter, and it had been driven into the sandy clay subsoil and cut level to support a large timber. The timber measured 13 x 15 inches in cross section. It lay horizontally at the level of the top of the sheets and was at least 5 feet in length (the east end was truncated by the heavy metal sheets of the cofferdam, which had knocked the timber askew as they were driven in). There was no evidence of additional timbers to the west (toward the channel), but the bulkhead was cut at about that point by the pilings of the 1936 bridge. There was no evidence of fasteners securing the timber to the post, and thus may have been held in place by its own weight and the pressure of the surrounding soil. The spacing of the posts could not be determined, since

only one remained in the excavation area. In addition to the post, a single vertical plank was located on the downstream side of the bulkhead. This plank bore similar measurements to those forming the face of the bulkhead. There was no evidence, such as molds or soil stains, to suggest that additional planks had been present forming a second line of sheet piles. And thus it was assumed that the plank was non-structural, perhaps serving as an aid to aligning the bulkhead timbers during construction. Figure 50 shows a reconstructed cross section of the bulkhead.

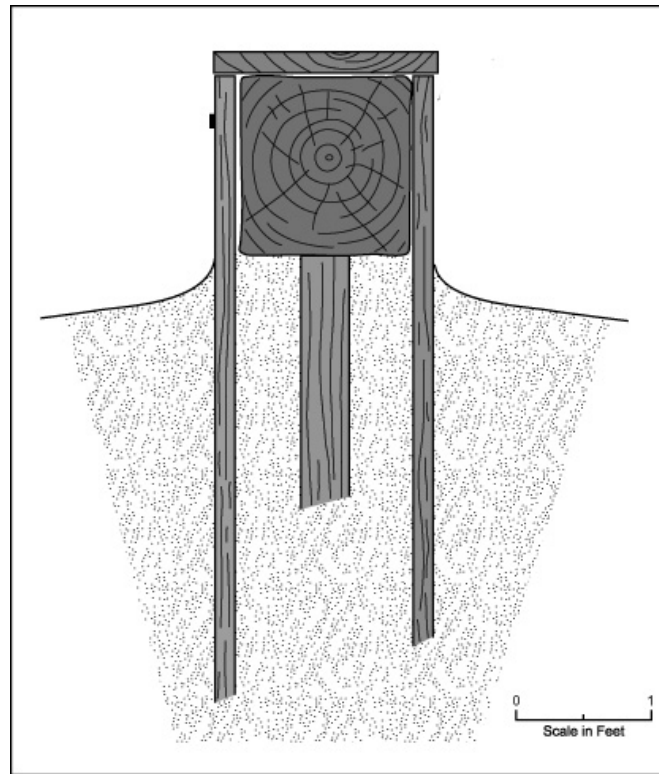


Figure 50: Reconstructed Bulkhead

A mortise joint, measuring 3 x 6 inches and 5.5 inches deep, had been cut into the surface of the large horizontal timber, near the west end. A fragment of cedar timber, measuring approximately 8 x 8 inches in cross section, was recovered from the fill above the bulkhead. A 4-inch tenon, cut to fit the mortise at an angle of approximately 20 degrees from vertical, was present at one end of the timber (Figure 51). The final element of this portion of the bulkhead was a heavy, 2.5 x 18 inch plank capping both the sheet piles and reinforcing timber. The plank had two mortise holes cut into it, one matching the mortise in the large timber below. The upstream edge of the plank, overlying the tops of the sheet piles, bore a beveled finish, while the downstream side, that lay against the bank, was squared off. The capping plank may have served as a shoe, a replaceable buffer to protect the underlying timber from damage. It is, in fact, unclear what kind of damage the timber may have been shielded from, since the specific function of the structure is not known. Yet, the presence of the mortise and tenon feature and the protecting shoe imply that there was some sort of heavy activity associated with the

structure. Fasteners attaching the capping plank and the sheet pilings to the large timber consisted of large cut nails and spikes.

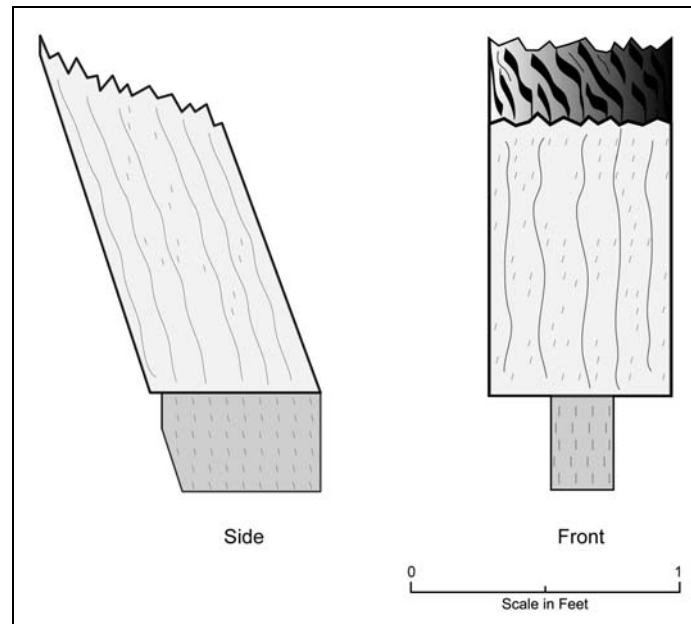


Figure 51: Cedar Timber with Mortise Joint.

At the east end of the feature, near the point at which it was truncated by the cofferdam, there was a formal break in the sheet piles. A series of 2.5-inch-diameter pinewood posts had been placed across the opening to form a grate, designed to catch large debris. One of the posts was removed for examination and was found to measure 54 inches in length, with the end trimmed to a point for driving into the subsoil. A large, 7-inch-diameter post was also present in the gap. It probably served as support for the large reinforcement timber, although both the post and timber appeared to have been displaced when the timber was pushed down and twisted by the force of the cofferdam sheeting. The opening in the sheet piling was at least 2 feet wide (the east end was truncated by the cofferdam). Debris, such as twigs, leaves and roots, lay in a dense mat against the base of the bulkhead. The material was particularly dense against the grate, and subsoil was washed out in a wide basin upstream from the opening, where water had eroded the sandy bottom deposits as it streamed through the opening.

An irregular gap, measuring about 7 feet in width, occurred between the sheet piling in the corner of the cofferdam and the piles in the channel, suggesting that the bulkhead had been disturbed by the construction of the 20th-century bridge. Further evidence of this was seen in a cut-and-fill sequence within the gap, indicating that the stream had cut through the opening, probably forming a temporary channel or chute during construction.

The sheet piles that lay in the stream channel, investigated as part of the survey and testing phase of the project, were more fully examined once the cofferdam was in

place and the flow of Gravelly Run diverted into the metal culvert. The deteriorated wood, originally identified as short segments of parallel planking, was indeed part of Bulkhead 2. Excavation revealed two sets of sheet piles. The longest was roughly aligned with the portion of the bulkhead to the east (described above). It extended 19 feet from the gap east of the stream channel (caused by the east bulkhead of the 1936 bridge), to a point at which it was truncated by the west bulkhead of the 1936 bridge. After a space of approximately 4 feet, the remaining sheets of Bulkhead 2 appeared, extending westward to the wall of the cofferdam. This part of the bulkhead was excavated as Feature 16. Three posts, Feature 19 (6 inches in diameter) and Features 25 and 26 (3 inches in diameter), were located south of, or downstream from the sheet piles, serving either as supports or alignment posts.

Upstream from the first line of sheets lay a second line, extending from the western edge of the present stream channel for a distance of about 14 feet. The distance between the two sets of pilings ranged between 10 and 12 inches. The planks making up the second line were more varied in width than those seen in the rest of Feature 2, ranging from 9 to 14 inches. In addition, the ends of the second set were finished differently; while they were single beveled, like the other planks, they had not been pointed. While seemingly minor, these differences suggest that the two sets of pilings were not put in place at the same time. An extensive cut-and-fill feature, designated Feature 24, lay adjacent to the upstream face of the bulkhead. This feature is described in detail below. In summary, it appeared to have been a deep erosional feature caused by backwash that scoured the stream bottom and undermined the bulkhead. The heavy rubble used to fill in the eroded area was noted between the two lines of pilings, and upstream for a distance of 3 to 4 feet. The second line of sheet pilings thus may have been an attempt at shoring up or reinforcing the most vulnerable part of the bulkhead, following the washout.

Features 16 and 15

As noted above, additional portions of the bulkhead lay to the west, across a gap of 4 to 6 feet that represented the disturbance caused by construction of the 1936 bridge bulkhead. The features were excavated separately, before the full configuration of the bulkhead was clear, and thus they were given separate feature numbers: Feature 16, two parallel segments of sheet piling; and Feature 15, an associated post. The planks making up Feature 16 were aligned with both sets of sheet pilings in Feature 2, to the east, indicating continuations of both lines, and that the upstream set of sheet piles, the repair to Bulkhead 2, extended well west of the stream channel. Feature 15 was a single pinewood post, 3 inches in diameter, lying on the upstream side of Bulkhead 2.

Feature 24

This was the only non-structural feature documented in the excavations. It consisted of a deep basin on the upstream side of Feature 2. The basin was filled with rubbly debris that included brick bats, large and small masses of slag, gravel, and black silty sediment that may have been decomposed coal. There were no chronologically diagnostic artifacts in the debris that could be confidently assigned to the period of deposition. (need to double check this statement) The basin measured approximately 20

feet in length, parallel to the sheet piling of Feature 2, and 3 to 4 feet wide at its widest point, near the center of the present stream channel. The cut was deepest near the face of the sheet piles, where it measured as much as 3 feet in depth. It was shallower and ill-defined to the west, away from the channel.

Feature 24 appeared to have been a deep erosional cut caused by backwash as water struck the bulkhead. Whether this occurred as a result of the continuous flow of the stream or was the result of a single, violent flood event is difficult to determine. In either case, the result was that backwash scoured out the sediments in front of the bulkhead and threatened to undermine the sheet pilings. The less well-defined nature of the feature west of the channel is consistent with this interpretation, since there would be lower energy flow away from the main channel, resulting in a shallower and less prominent cut infilled with finer sediment.

Wing Wall

Feature 7

Feature 7 consisted of an alignment of sheet piles extending northwestward from Feature 2, at an angle of approximately 40-45 degrees from the line of the bulkhead and beginning near its the west end. The individual planks, which measured 1.5 x 14 inches, were poorly preserved. All of the top ends were broken or deteriorated. As a result, precise elevation information was not available, yet all of the sheets were lower than the height of the complete portions of Feature 2. There were missing piles in two sections of the alignment, one near the cofferdam wall, and a second at the disturbance left by the 1936 bridge bulkhead. The latter occurred at the intersection of the wing wall and the main elevation of Bulkhead 2, so that the connection between the two sections of sheet piles was no longer present.

Feature 14, 22 and 23

A series of posts was located between Feature 7 and the cofferdam. Feature 14 was a 3-inch-diameter pinewood post; Feature 22 was a 5-inch-diameter cedar post; and Feature 23, a 4-inch-diameter pinewood post. Both Feature 22 and Feature 23 were adjacent to the sheet plies of Feature 7, and were aligned with it. Based on the configuration of the other bulkhead fragments excavated within the cofferdam, these posts would have supported a now missing timber that reinforced the sheet piles of the wing wall. The association of Feature 14 with Feature 7 was not clear, since the post lay more than 2 feet from the pilings.

BULKHEAD 3

Bulkhead 3 consisted of discontinuous fragments of sheet piling that stretched across the channel of Gravelly Run, along with fragments of wing walls extending upstream from both the east and west ends (Figure 44). While most of the individual features comprising the bulkhead were poorly preserved, the accumulated data from the remnants suggested that construction techniques were similar to those observed in

Bulkhead 2. That is, sheet pilings were driven into the sandy clay of the stream bottom, and reinforced by posts and massive timbers laid horizontally behind (downstream from) the pilings.

The components of the bulkhead were fragmentary; they were investigated and documented separately, given individual feature numbers as they appeared during excavation. The bulkhead pilings on the east side of the stream channel were designated Feature 8, and the corresponding posts were labeled Features 9 and 10 (Figure 52). The associated wing wall fragment on the east side of the stream was recorded as Feature 4. West of the stream, the sheet piles occurred in two sections, designated Features 11 and 17. Feature 12 was an associated post, while the wing wall on the west side was designated Feature 5. Scattered posts near the middle of the stream channel were designated Features 6 and 21. There were no surviving sheet piles from Bulkhead 3 in the stream channel.

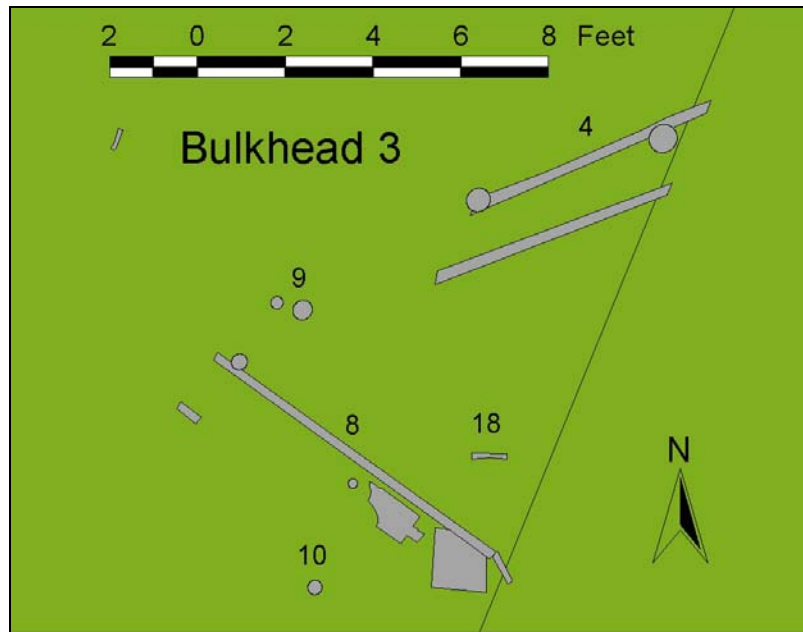


Figure 52: Bulkhead 3 on East Side of Stream Channel

Feature 8

Feature 8 consisted of a series of sheet piles, oriented parallel to Feature 2 (Figures 53 and 54). The planks measured 2 x 10.5 to 2 x 12 inches, and had been driven into the stream bottom and cut flush at or near present mean sea level. Like the sheet piles in Feature 2, these planks had been single-beveled to force them together as they were driven into place. They were shorter than the planks in Feature 2, measuring about 5 feet in length. Circular saw marks were visible on the plank faces. Estimates of the diameter of the saw were made both manually and mathematically (measuring the rise and chord): the estimated blade diameter was 35 to 45 inches. Two-foot diameter circular saws were introduced in the US in 1819; they were common in Maryland by the 1830s and 40s (Marsh 1998).

Four-inch-diameter pinewood posts were located directly behind (downstream from) the sheet piles. Individual sheet piles, that may have served as alignment planks, were situated in a line beyond the posts, approximately 15 inches from the main face of the bulkhead. While no reinforcing timber was observed on top of the posts, the spacing of the planks and posts suggested that one had originally been present. A large timber measuring 12 x 15 inches in cross section was noted near the cofferdam wall, but it sat vertically in the sediment behind the sheet piles. The timber did appear to be similar to that used to reinforce Feature 2, and its unusual orientation may have been the result of disturbance associated with the cofferdam installation. A deteriorated 2 x 20-inch plank was located in the fill directly above Feature 8, and may have been a capping plank disturbed by the cofferdam sheets. While no mortise holes were noted in the plank, a fragment of cedar timber, 5.5 x 8 inches in cross section, with a 4-inch tenon cut at one end was also found in the fill directly above Feature 8. The end of the timber opposite the tenon had been burned.

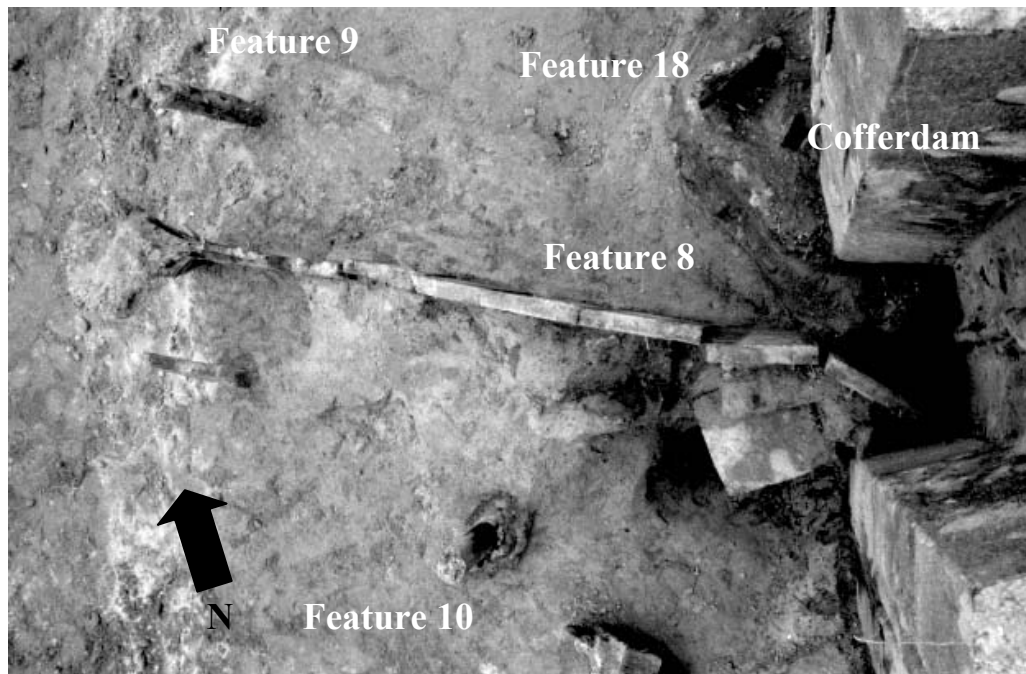


Figure 53: Planview of Bulkhead 3, Feature 8.

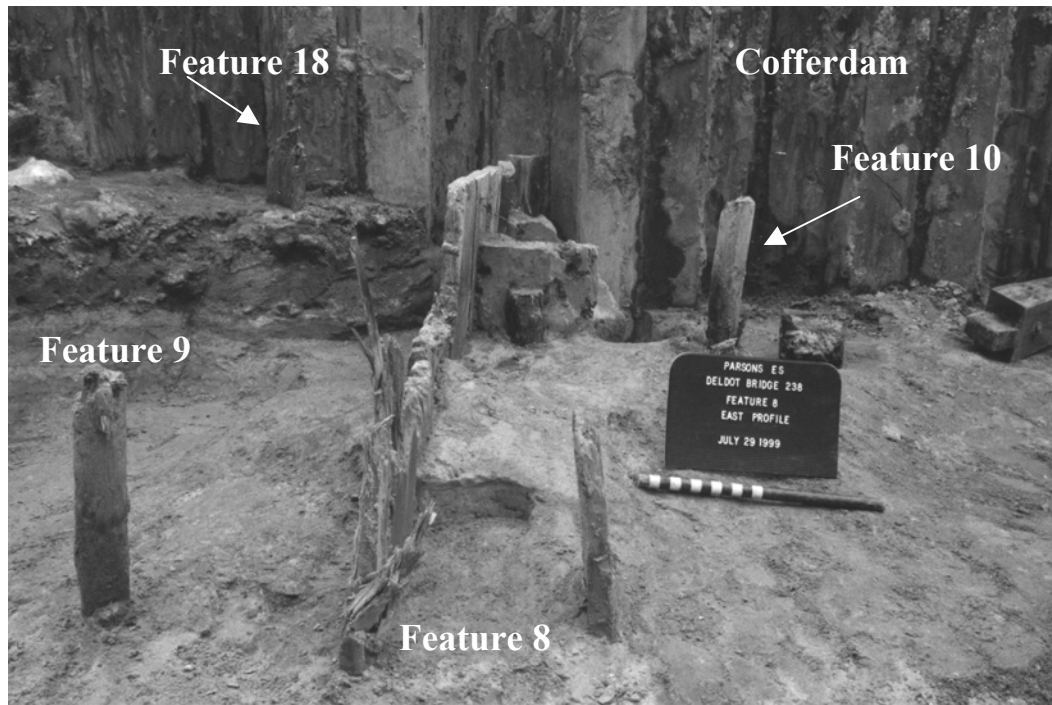


Figure 54: Bulkhead 3, Feature 8, Facing East.

Subsequent to the excavations within the cofferdam, Parsons monitored excavations for the installation of wing walls for the new bridge. These excavations were perpendicular to the cofferdam. Excavations for one of these wing walls exposed further remains of Feature 8. Observation showed that feature 8 extended an additional 2 feet into fast land from what was visible in the cofferdam. This shows that most of the foundation remains were exposed by the cofferdam excavations, and that little more can be expected outside the footprint of the new bridge.

Features 6, 9, 10, 21

Four additional posts, Features 6, 9 and 10, were located near Feature 8. Feature 9 was 4-inch-diameter pinewood post that lay 18 inches upstream from the bulkhead. Feature 10 was a pinewood post of similar diameter, located 2 feet south of the bulkhead sheet piles. Both posts consisted of sharpened but unfinished wood, with bark still remaining on the exterior. Their specific function in relation to the bulkhead could not be determined. Features 6 and 21 were highly deteriorated pinewood posts on either side of the stream channel lying at roughly the same distance from Feature 8 as did Feature 10. While weathered, their original size appeared to have been the same as that of Feature 10 (4-inch diameter), and they probably served a similar purpose, possibly for general alignment during construction.

Wing Wall East of Stream Channel

Feature 4

Feature 4 consisted of an alignment of pinewood sheet piles extending northward from Feature 8 at an angle of 55-60 degrees. The planks measured 2 x 15 inches, and were approximately 45 inches in length. They were single-beveled, but not pointed, and had been driven into the clay subsoil. No saw marks were visible on the surface of the planking.

There were no posts visible behind the sheet piles in Feature 4, but a 10 x 10-inch timber lay horizontally behind (downstream from) the sheet piles. Two mortises were cut into the timber. One, facing upward, measured 3 x 6 inches; the second was cut into the south, or downstream face of the timber. The west end of the timber had been beveled to an angle of about 45 degrees. There was no indication as to whether these features were directly functional (the mortises intended for structural purposes, for example), or whether the timber had merely been recycled. Four-inch roseheaded cut nails were driven through the sheet piling to secure the timber. A 2 x 10-inch plank lay horizontally behind the timber. One end was beveled in a similar manner to the timber, suggesting 1) that the plank was a capping board knocked askew by the cofferdam sheets, and 2) that the bevel on the large timber was not incidental; that is, the timber and capping plank had been shaped together as part of a splice joint with an additional timber to the west.

Main Bulkhead East of Stream Channel

Features 17, 11, 12

Like the component features of Bulkhead 2, the parts of Bulkhead 3 west of the stream were more poorly preserved than the corresponding material on the east side of the channel. The main bulkhead pilings, Feature 17, were very fragmentary. Only two sheets (measuring 2 x 10 and 2 x 11 inches) and a fragment of a third were present. While there no horizontal reinforcing timber was noted, several elements implied that one once existed: a 4-inch-diameter pinewood post behind the sheets; cut nails near the tops of the planks; and a single vertical plank, parallel to and 15 inches south of the main line of sheets.

Feature 17 was truncated to the west by the cofferdam, and to the east by the construction disturbance associated with the 1936 bridge bulkhead. Features 11 and 12 comprised the only remnants of Bulkhead 3 between the modern bridge and the stream channel. Feature 11 was a vertical alignment plank located behind the bulkhead, while Feature 12 was a 4-inch-diameter pinewood post.

Wing Wall West of Stream Channel

Feature 5

Feature 5 consisted of the fragmentary remains of a line of sheet piling that extended northward from Feature 17 at an angle of 45 degrees. The planks measured 2 x

11 inches. The tops of the planks were deteriorated, and thus it was difficult to obtain an accurate height measurement, but the level was somewhat above that of either of the two bulkheads, Feature 17 or Feature 2. The northern end of Feature 5 may have been the formal end of the bulkhead, since clean sediments, with no evidence of additional, now missing planks, were noted between the last plank and the cofferdam wall. The sheet piles extended approximately 5 feet to the east, toward the stream and Feature 17, while the molds of rotted or extracted planks continued an additional 4 feet, at which point they met the disturbance from the 1936 bridge bulkhead.

MISCELLANEOUS

Feature 3

A series of upright timbers or planks observed beneath the 1936 bulkhead during the survey and testing phase of the project. The features were only visible at low tide, and while not clearly defined, appeared to be oriented parallel with the later bridge features, rather than the earlier bulkheads that were the focus of the data recovery investigations. They were originally noted at the corner of the bridge abutment, but were not seen again during the excavations within the cofferdam. Based on their orientation, the planks may have been associated with the construction of the 1936 bridge.

Feature 13

A 4.5-inch-diameter pinewood post lying south of Features 11 and 12 (Bulkhead 3). The post was not associated with any of the documented bulkhead features, and its function is uncertain.

Feature 18

A single plank north of Feature 4. It measured 1.5 x 10 inches, and was heavily weathered. The plank was not oriented with any of the bulkhead features, and may have been part of the fill – it lay near the cofferdam wall and may have been pushed askew by the heavy metal sheets.

Feature 20

A 5-inch-diameter pinewood post, isolated south of Feature 2 in the main channel of Gravelly Run.

STREAM CHANNEL INVESTIGATION

Several backhoe cuts were made into the sediments in the stream channel. The purpose of the excavations was to better understand the dynamics of Gravelly Run – how its course may have varied through time and how that variation may have affected the presence or location of mill features, such as a wheel or waste gates.

One of the initial questions at the start of the investigation at Bridge 238 was whether or not there had been a mill structure here at the east end of the dam. Period maps indicate mills on the dam to the west, on the main branch of the Nanticoke, but by 1860 the only notation in the area of Bridge 238 was “Waste Gates.” The question remained as to whether there had been an earlier, unmapped mill or forge on Gravelly Run – was the stream actually a millrace, leading to a wheel at the dam? It is conceivable that structural features were present but had been considered an impediment to bridge construction in 1936 and were thus removed prior to the installation of the modern embankment and bulkheads. If so, evidence of things such as a wheel pit might be seen in a filled-in excavation at or near the stream channel. In partial answer to this question, the excavations within the cofferdam revealed no structural remains that appeared related to a mill other than for water control.

Channel Excavation

The main archaeological excavation in the channel deposits was conducted parallel to the stream, on the east side of the diversion culvert. A trench, 4 feet in width, was excavated over a distance of approximately 35 feet as measured from the south wall of the cofferdam, 6 feet short of the length of the 1936 bridge bulkhead (Figure 42 – overall plan). The trench was excavated to an average depth of 7 feet below mean sea level, well into undisturbed Pleistocene subsoil.

South of Bulkhead 2, alluvial sand and gravel, representing the recent bed of the stream, began at a depth of 2.5 feet below mean sea level, and lay directly over sandy clay subsoil (Figure 55). Feature 24, the deep pit created by backwash, lay immediately north of the bulkhead. Beginning 3 to 4 feet farther north, beyond Feature 24, was a series of lens-like strata lying in a wide basin. Describing the strata from the bottom up, the base consisted of light gray sandy clay subsoil, consisting of the top of the undisturbed Pleistocene sands that underlie much of the Coastal Plain of Delaware. Lying directly over this sand in an abrupt transition was a layer of coarse sand and gravel. The distinct transition from the underlying subsoil to the coarse alluvium indicated that the subsoil had been cut, probably by fast-moving water. The latter conclusion stems from the size range of the gravel in the coarse-grained layer, since the material would have been carried by a relatively high-energy flow. These lowest strata, then, appeared to record the effects of a flood episode that cut a wide basin in the subsoil and deposited a layer of sand and gravel within it.

The gravel stratum was relatively uniform in thickness, measuring between 3 and 6 inches. Overlying it was a layer of gray colored, medium coarse sand mixed with small gravel. The transition to this gray sand was less sharp than the transition between the underlying layers, suggesting that the material was a natural alluvial deposit that had accumulated as the stream flow that laid down the coarser gravel lessened. The sand layer measured 6 to 12 inches in thickness, and stretched across the entire basin, from the deep deposit in front of Bulkhead 2 (Feature 24) to the north, or upstream end of the archaeological trench.

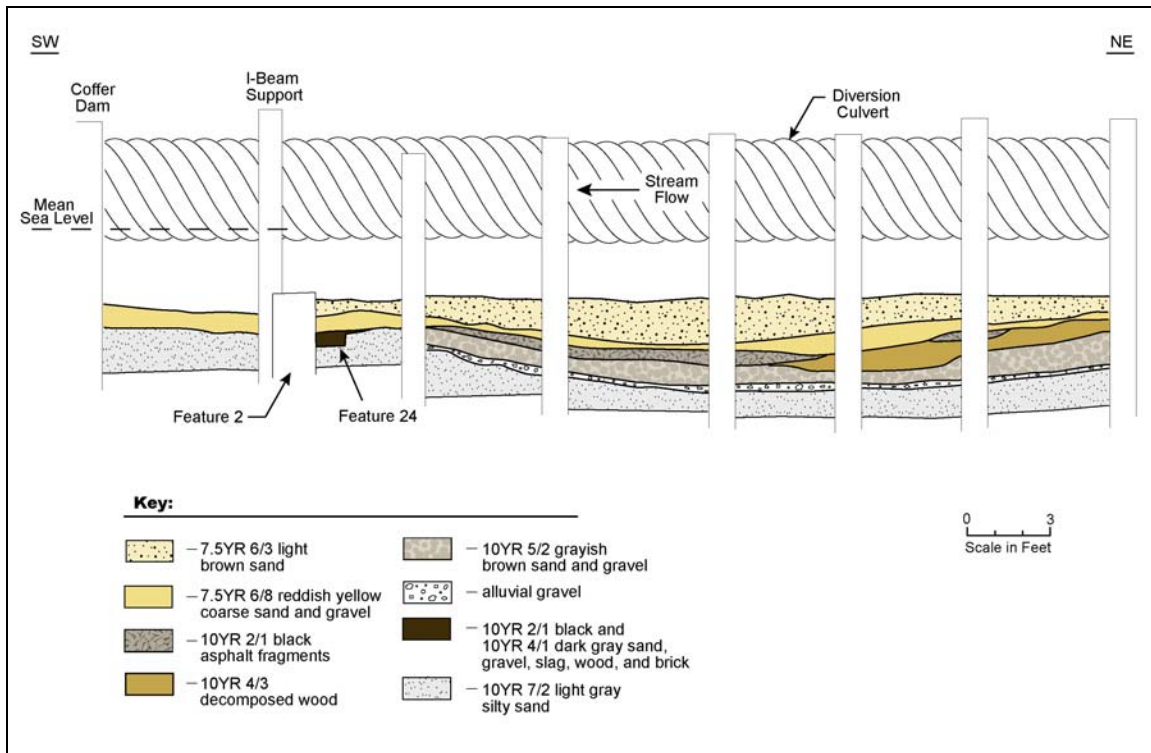


Figure 55: Stratigraphy, along Streambed.

The layers above the gray sand were more varied than those below. A deposit of heavy rubble, measuring 8 to 12 inches thick, stretched northward from Feature 24 for a distance of approximately 18 feet. The layer consisted largely of gravel and asphalt, along with fragments of concrete and metal. It sloped downward into the basin, where it eventually mixed with lighter gray sand that contained gravel, woods chips and branches. This woody debris layer was 3 to 9 inches thick, and sloped upward following the north edge of the basin. A thin, discontinuous layer of asphalt and gravel overlay the woody debris, suggesting that the wood layer was once more extensive, but had been cut and partially filled over by the layer of asphalt and gravel.

Overlying these two debris layers was a deposit of coarse brown, iron-stained sand, the upper portions of which were crusty and partially cemented in some places. The layer stretched the entire length of the trench excavation. It was thin throughout much of its length – 2 inches or less in thickness – but to the north it had accumulated in a low area to as much as 8 to 9 inches. This deposit appeared to represent the most recent base of the stream. Some of the material, including small gravels that lay near the surface of the deposit, had been lost to erosion during and after the cofferdam was installed, as water continued to flow from the culvert and from gaps in the cofferdam wall.

A final layer of sand covered the entire basin, consisting of a light brown to yellowish brown medium to fine grained sand, that measured as much as 18 inches in depth. This deposit was a recent addition to the basin, and was comprised of fill material

from the 1936 bridge bulkheads that had washed into the stream channel during the installation of the cofferdam and diversion culvert, as well as during the archaeological removal of the bulkhead fill.

Possible insight into the timing of the flood that produced the basin just described was provided by a local informant, who noted that the road that is now S 46 was washed out in a heavy storm in the 1930s. This was probably the 1935 flood that washed out the bridge, necessitating construction of Bridge 238 (DelDOT 1991). The informant noted that it was “the old 9-foot road” that washed out. The 9-foot road was the county road that consisted of a single lane of concrete pavement, nine feet in width. In the first quarter of the century, there was little enough vehicular traffic on most roads that a single lane was all that was necessary. When on-coming traffic appeared, vehicles would move to their respective shoulder and share part of the paved road. As traffic and speeds increased, so did the need for a road that could carry opposing lanes. The bridge over Gravelly Run may have remained a single lane until it was destroyed in a flood, occasioning the construction of the two-lane Bridge 238. Thus the wide basin north of Bulkhead 2 appeared to have been the remains of the flood that destroyed the older bridge, while the concrete and asphalt debris observed in the basin may have been the remnants of the ensuing demolition used to fill in the stream channel.

While excavating the trench, the equipment operator noted that the backhoe was less stable the farther north along the trench he excavated. This suggested that the underlying sediments were unconsolidated, probably consisting of the same fill sequence documented in the archaeological trench. It appeared, then, that the backhoe had crossed over the original channel, which lay more to the east than it does today. And as indicated earlier, were the channel located in this area, it would have been perpendicular to the bulkheads found archaeologically.

CONSTRUCTION MONITORING

Subsequent to the excavations in the cofferdam, Parsons monitored installation of new wing walls for the new bridge. During monitoring of the wing wall installed at the southeast corner of the bridge, timbers were encountered that were likely the extension of Feature 8, where the wood foundation originally extended into fast land (Figure 56). The monitoring results suggest that Feature 8 extended less than four feet beyond what was exposed in the cofferdam.

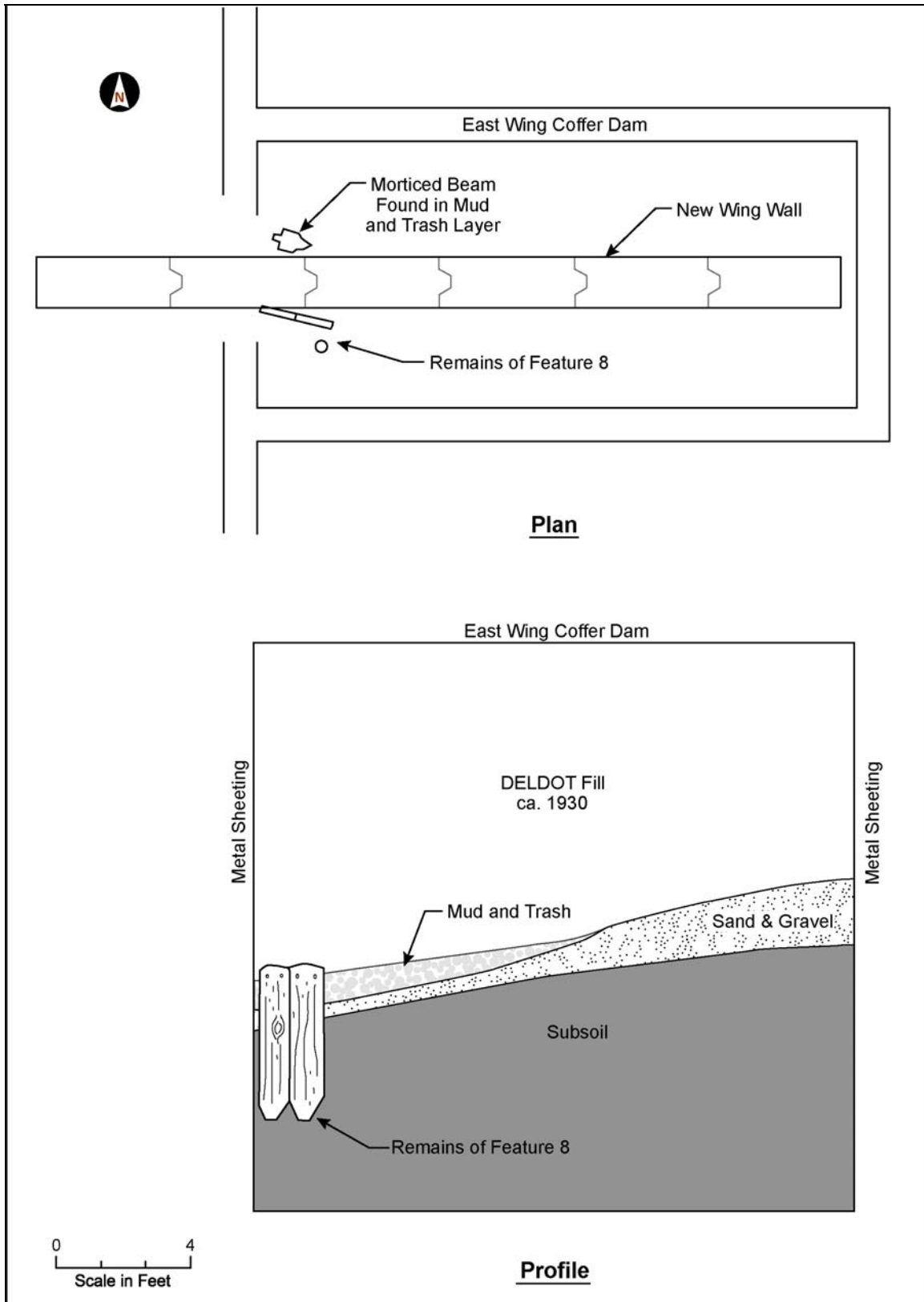


Figure 56: Wing Wall Monitoring, Plan and Profile Views.